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Commercial Technology Program



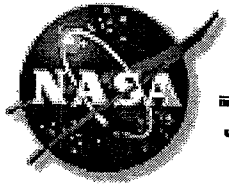
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PITTCON 2002 New Product Forum March 17, 2002

Presented by:

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Licensing/Partnership Opportunities Radiometer Technologies

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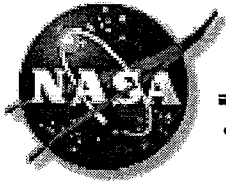


Radiant Temperature Nulling Radiometer (NASA Stennis Case Number: SSC-00124)

Polarization Enhanced Thermal Radiometer (NASA Stennis Case Number: SSC-00134)

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Technology Background

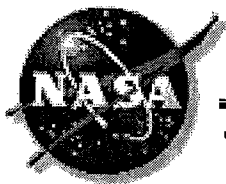
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- NASA and other government agencies routinely calibrate thermal remote sensing satellites and airborne imaging systems by measuring water body temperatures
- Temperature measurements approaching 0.1 °C accuracy are required
- Existing technologies are extremely power hungry, drift over time, do not allow for continuous monitoring, and are subject to complex atmospheric correction

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NASA Relevance

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- Remote monitoring of the temperature of water bodies
- Improved calibration of thermal imaging systems
- Ground truth for thermal applications
 - Handheld infrared thermometer
- Expected further support

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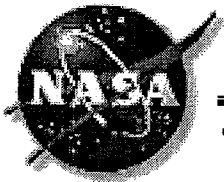


Radiant Temperature Nulling Radiometer

(NASA Stennis Case Number: SSC-00124)

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Nulling Radiometer

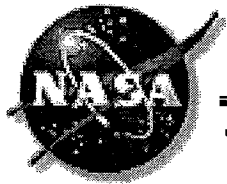
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- Using a controllable thermal source and a infrared thermometer a very accurate and stable thermometer can be achieved
- Intrinsically self calibrating
- Low Power

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Research & Development Status

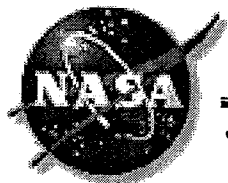
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- Development stage
 - Design Stage
 - General radiometer is designed
 - Critical electromechanical subsystems have been prototyped
- Development hurdles
 - Full integration and packaging

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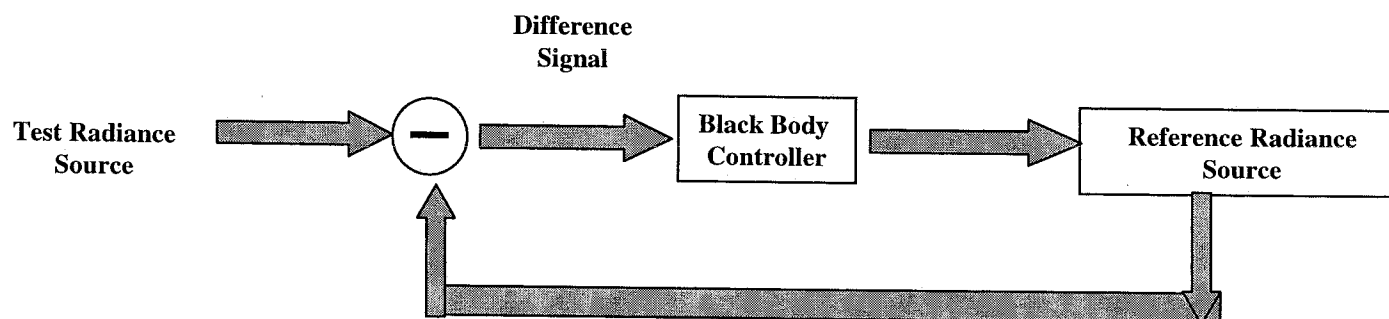
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Nulling Radiometer Principles

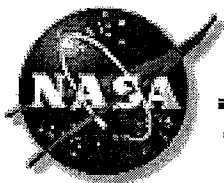
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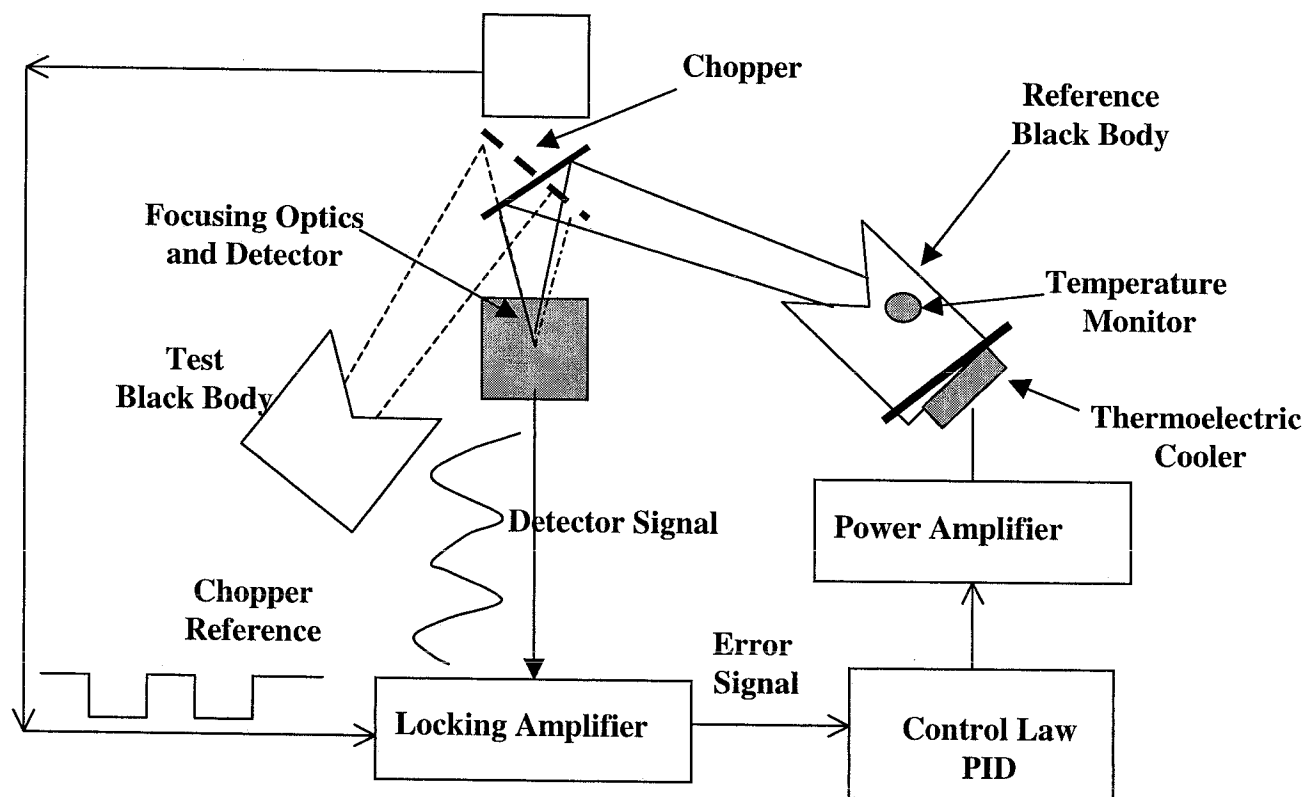
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Nulling Radiometer Subsystems

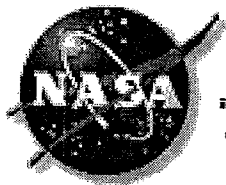
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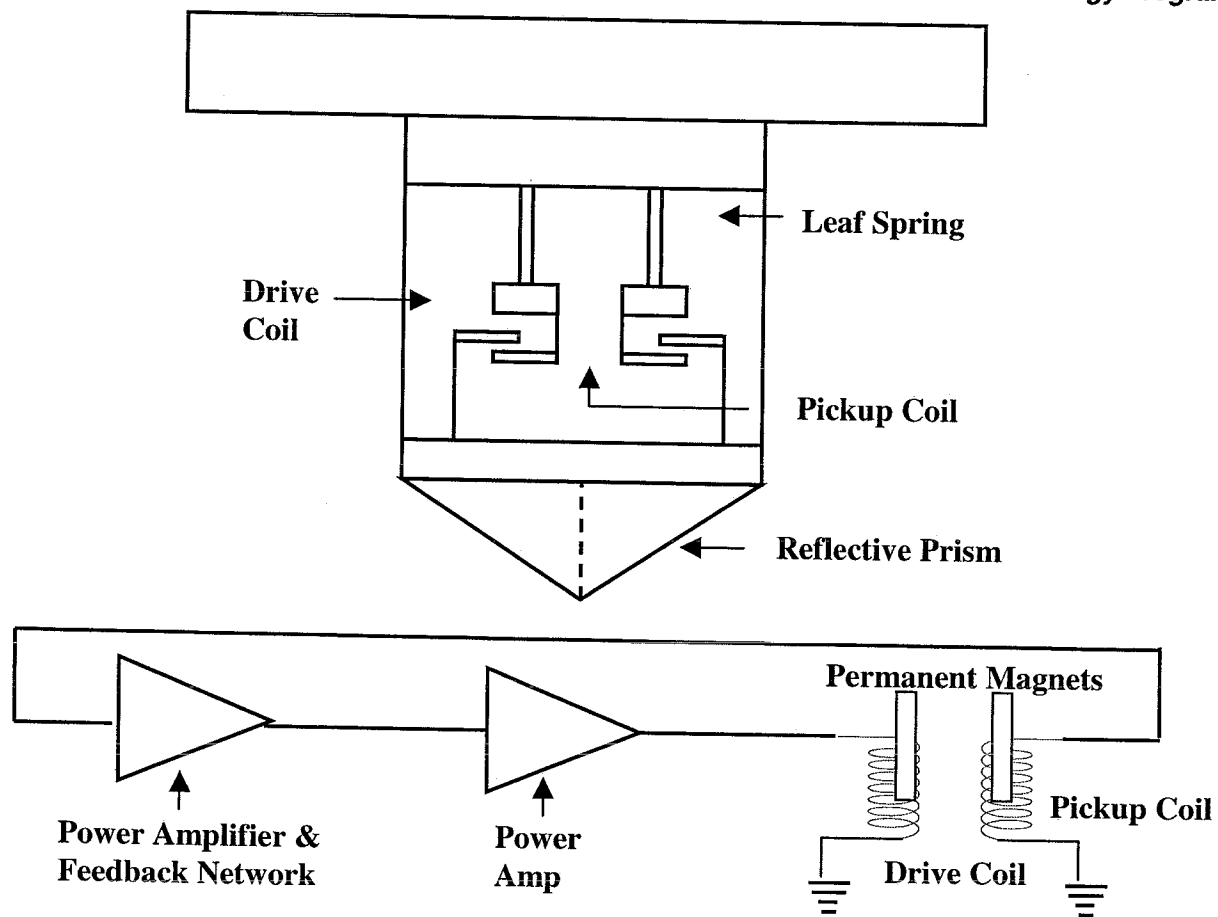
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Nulling Radiometer Chopper

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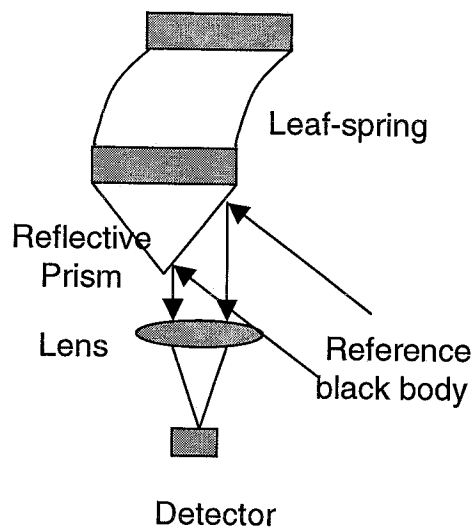
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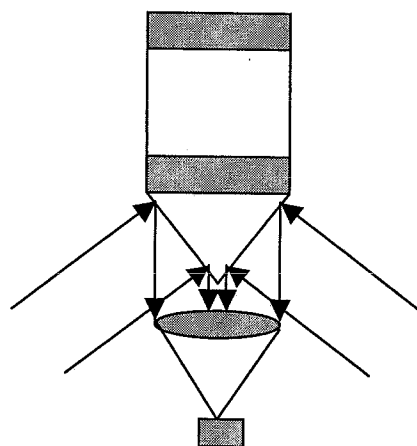
Nulling Radiometer Chopper (cont)

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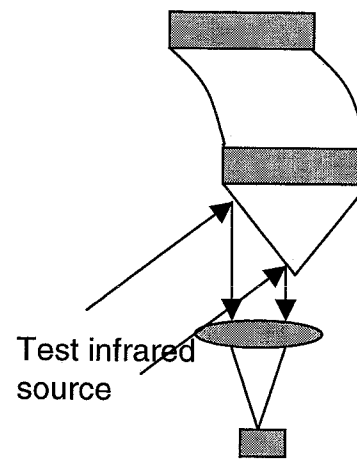
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a) Reference black body only



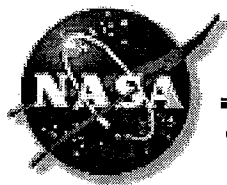
b) Both reference and test infrared source only



c) Test infrared source only

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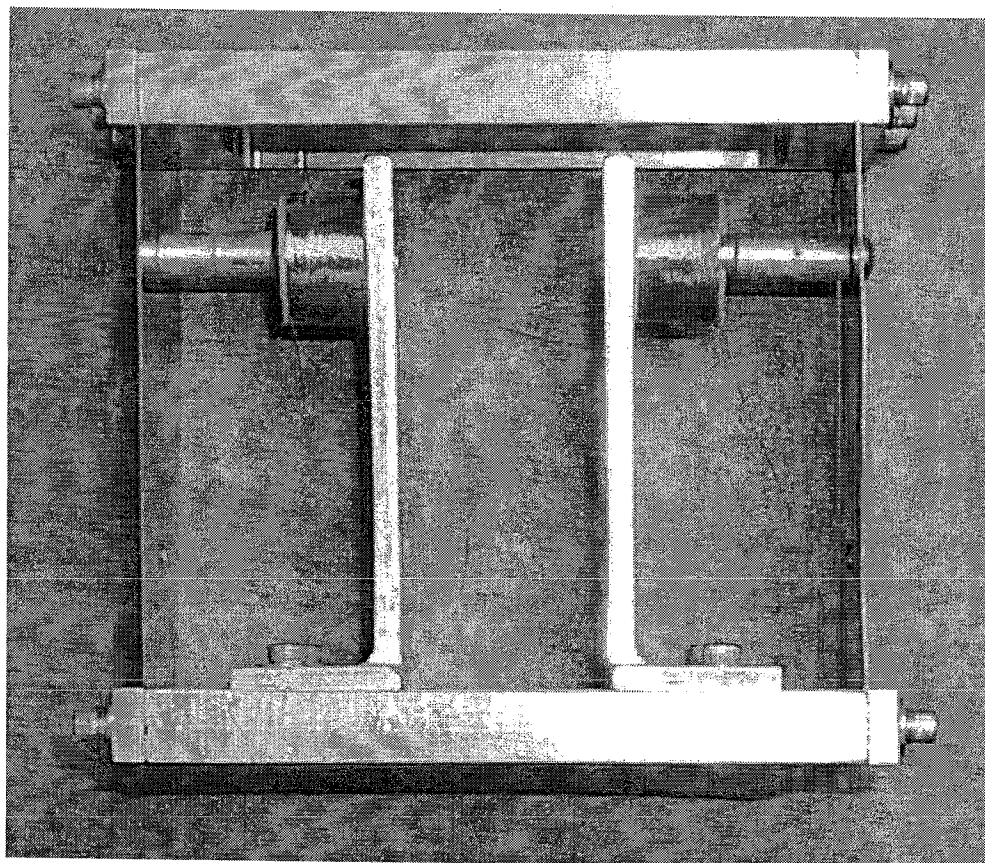
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Nulling Radiometer Hardware

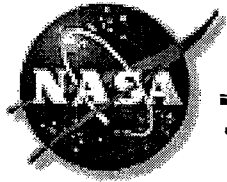
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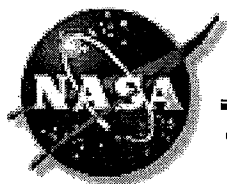
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Technical Advantages of the Nulling Radiometer

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- Requires only a single calibration source near the temperature of the test object
- Novel low power electromechanical optical chopper
- Self calibrating
- Faster time response and lower power than other accurate and stable systems
- Continuous monitoring
 - High duty cycle
- Low power
- Temperature accuracies on the order 0.1 °C are achievable



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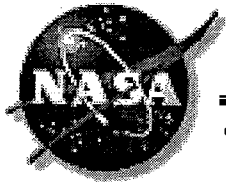


Polarization Enhanced Thermal Radiometer

(NASA Stennis Case Number: SSC-00134)

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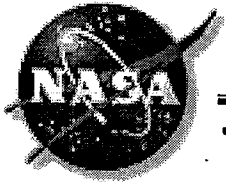
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Brewster Angle Radiometer

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- Measures polarized infrared emission at the Brewster angle where the emissivity of the surface is unity
- Improves overall temperature accuracy of infrared thermometer for weakly absorbing dielectrics by eliminating stray sources



Research & Development Status

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- Modeling of the phenomena has been made along with sensitivity to design parameters
- Laboratory proof of concept has been made

Development hurdles

- Full integration and packaging

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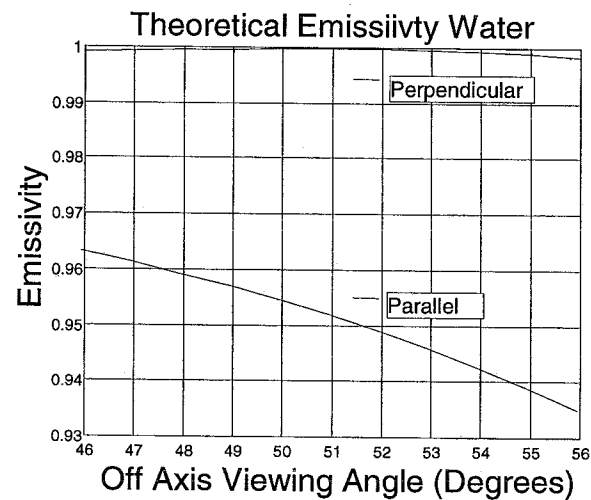
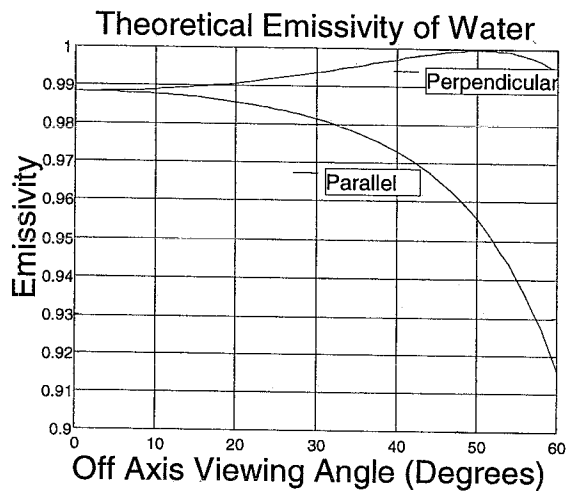
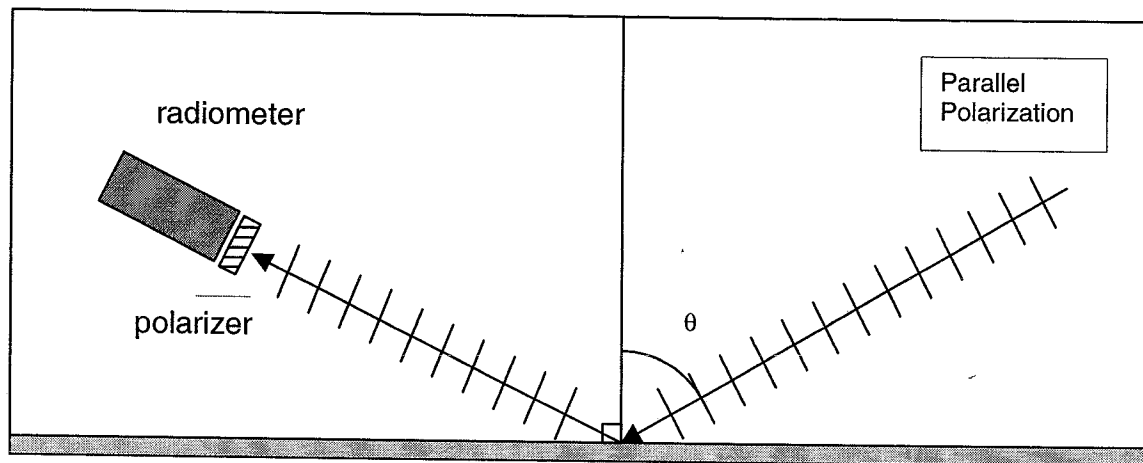
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Theory of Operation

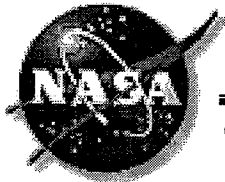
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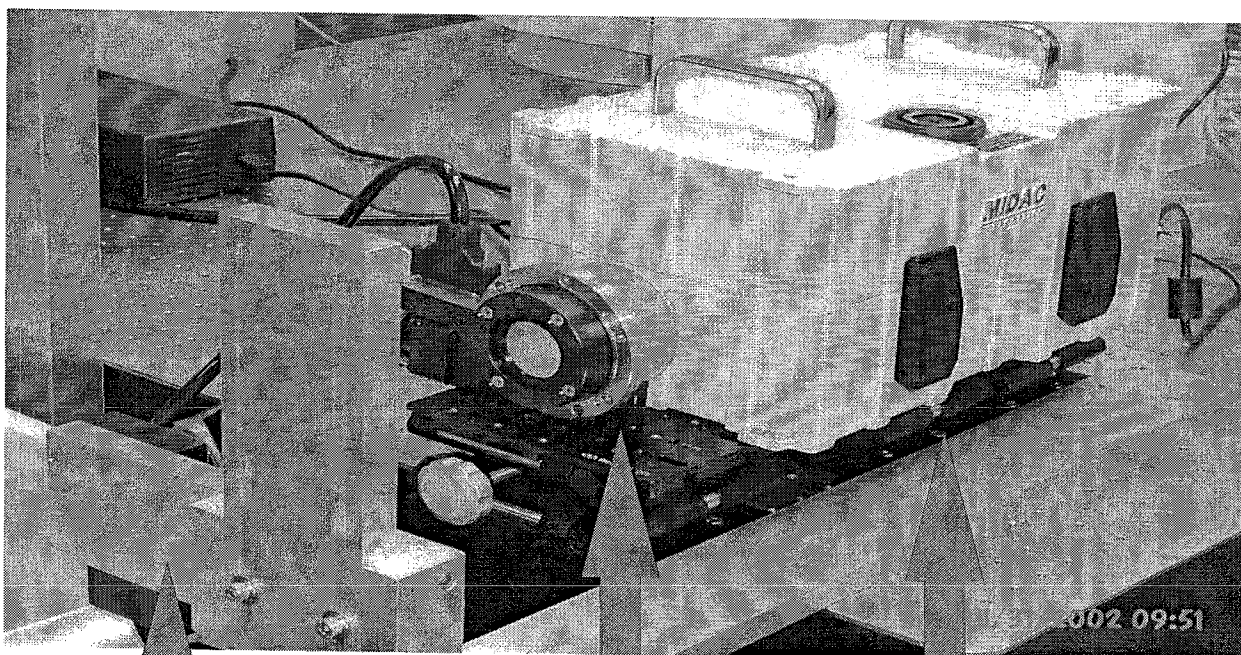
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Experimental Approach

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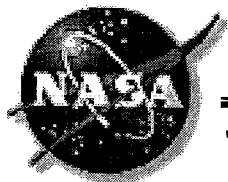
Scan Mirror

Polarizer

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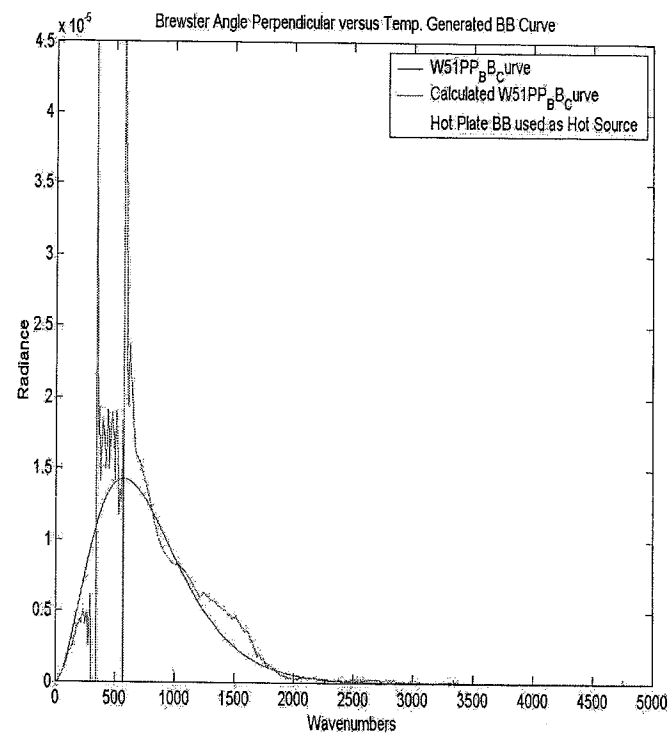
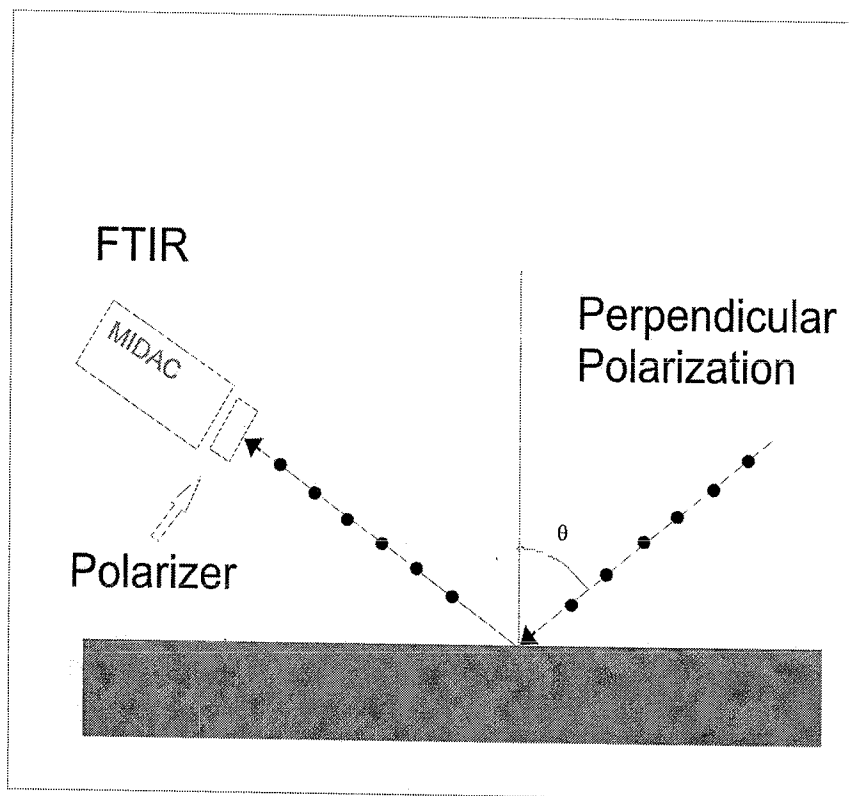
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Perpendicular Polarization

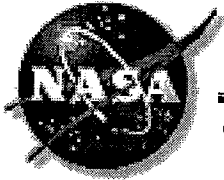
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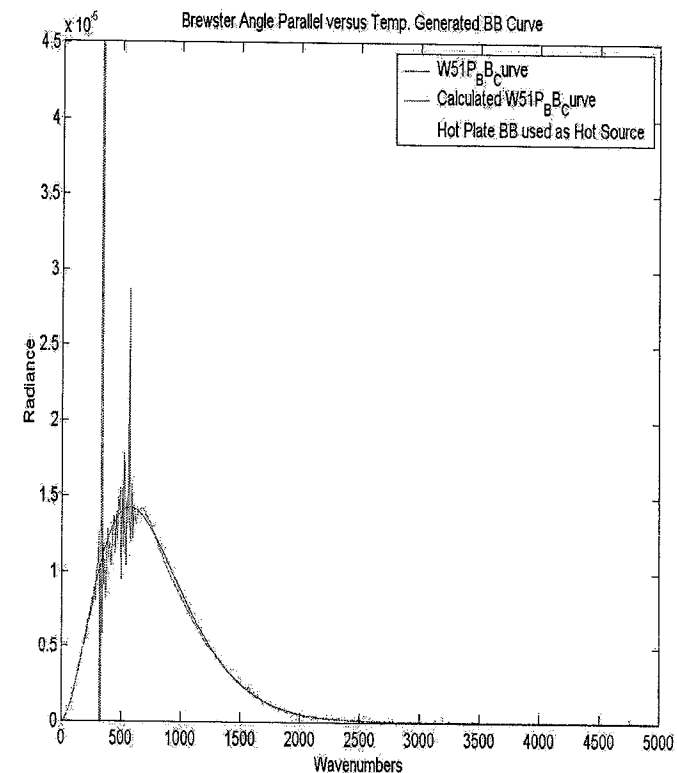
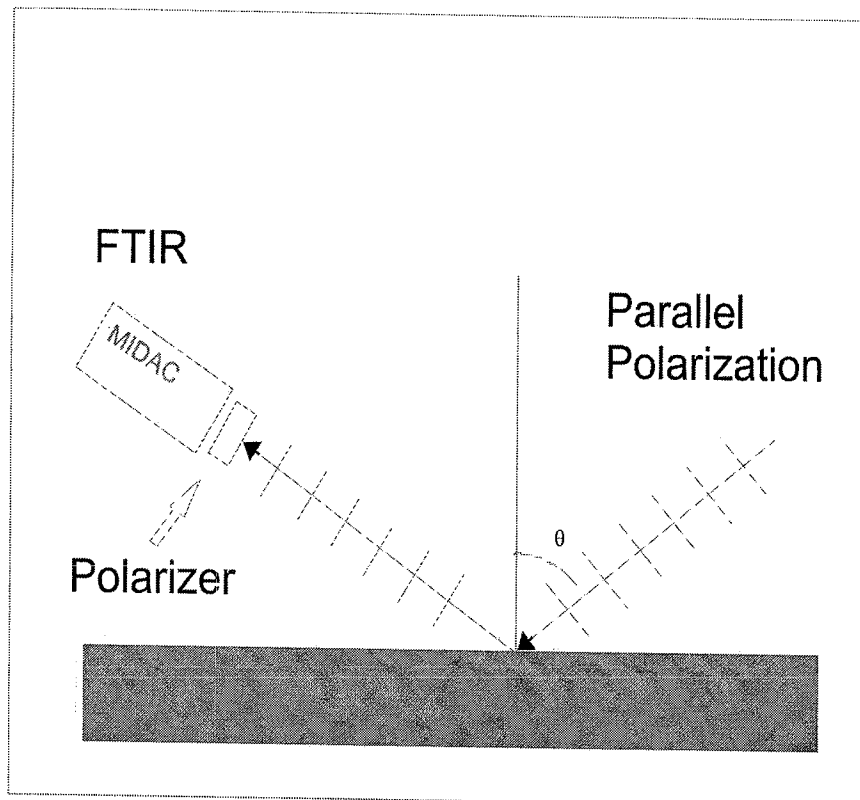
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Parallel Polarization

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Note Excellent Agreement in Atmospheric Window

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Technical Advantages of the Brewster Angle Radiometer

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- Polarized thermal radiometer at Brewster angle eliminates the need for complex corrections for emissivity and surroundings
- Temperature accuracies on the order of 0.1 °C are achievable
- Simple to implement
- Minimal modeling necessary to determine temperature
- Easy to calibrate

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Remaining Research & Development for Both Technologies

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- Technical risk
 - Low cost polarizer (Nulling Radiometer)
 - Low (Brewster Angle Radiometer)
- Remaining milestones
 - Full integration (Both Technologies)
- Future enhancements
 - Combination of technologies into one package
- Need for outside expertise or resources
 - Outside packaging expertise needed

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Technology Benefits for Both Technologies

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- Both technologies minimizes calibration needs
- Both technologies improves accuracy
- Nulling Radiometer increases utility in harsh thermal environments
- Nulling Radiometer reduces human intervention
- Nulling Radiometer - Low Power Requirement
- Brewster Angle Radiometer decreases complexity of measurement
- Brewster Angle Radiometers ease of integration into existing radiometers



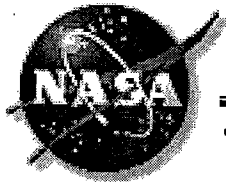
Potential Applications for Both Technologies

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- Commercial / Government
 - NASA and NOAA satellite calibration
 - Department of Defense Applications
 - Global Warming
- Process Control
 - Chemical/petrochemical
 - Power Generation
 - Aerospace
 - Materials
- Infrared radiometers for weakly absorbing dielectrics
 - Water
 - Polymers



NASA Plans/Options

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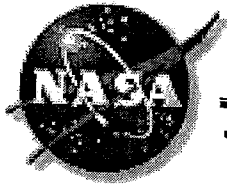
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- Continued internal development of both technologies
- Partnering
 - Dual Use Technology Development
 - Interagency Partnering
- License Technology for Commercialization

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Intellectual Property

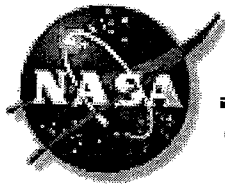
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- Patent Pending
 - NASA has filed a Patent Application on both technologies
- NASA has the authority to license the technologies pursuant to 35 USC 207-209
- NASA has the authority to grant Exclusive, Partially Exclusive, or Nonexclusive licenses on both technologies

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Licensing Opportunity

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- Parties interested in licensing this technology or partnering with NASA for further development should contact the Commercial Technology Program at John C. Stennis Space Center at:

Phone: (228) 688-1929

E-mail: technology@ssc.nasa.gov

<http://technology.ssc.nasa.gov>

Reference Technology Case Numbers:

SSC-00124, Radiant Temperature Nulling Radiometer

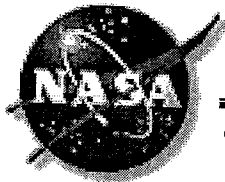
SSC-00134, Polarization Enhanced Thermal Radiometer

OR

While at PITTCON come see us at booth number 5619

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THANK YOU

Questions?

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